1. title page

The ED Pharmacist as a Safety Measure in Emergency Medicine

Supported by: Agency for Healthcare Research and Quality
Grant Number 5 U18 HS015818-02 "Partnerships in Implementing Patient Safety"

Project Officer: Eileen Hogan, MPA
Contract Dates: July 1, 2005, to June 30, 2008
(including 1-year no-cost extension)

FINAL PROGRESS REPORT

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2. ABSTRACT

PURPOSE: The purpose of this PIPS project was to optimize the role of emergency pharmacists (EPh), assess acceptance, evaluate impact, and create a comprehensive toolkit for EDs creating new programs. SCOPE: This project 1) optimized the role for patient safety; 2) studied the impact of the EPh on patient safety; 3) examined ED staff perceptions; 4) surveyed the prevalence of EPh programs in emergency medicine residency hospitals; 5) completed a time-motion study; and 6) created resources to assist startup programs. METHODS: (respectively) 1) qualitative assessment; 2) chart review methods; 3,4) survey instrument; 5) time-motion study; and 6) resources produced. RESULTS: 1) Seven emerging themes were identified for the optimization phase. 2) Chart review examined 10,224 cases and found no difference in adverse drug events with EPh in ED; however, there was a trend toward improvement in certain quality measures. 3) Of responding staff, 99% felt that the EPh improves quality of care. 4) Eight percent of academic EDs surveyed reported that EPh services were available 24 hours a day, but 70% reported no coverage. 5) The EPh spent the highest percentage of time with communication events, roaming, and resuscitation efforts. 6) Resources developed are available on the website www.EmergencyPharmacist.org. KEY WORDS: Emergency Medicine, Pharmacy, Medical Errors

3. PURPOSE

This project implemented and optimized an ED pharmacist (EPh) program as a safe practice intervention in a large Emergency Department (ED) and studied staff perceptions, status of national programs, and the impact of the program on quality and patient safety. In addition, a time-motion study of the emergency pharmacist role was completed. A secondary purpose of this project was to develop a complete toolkit that provides resources needed for an institution to justify, hire, implement, and evaluate an emergency pharmacist program in their emergency department.

4. SCOPE

Background. Involvement of clinical pharmacists in patient care in the inpatient hospital setting results in safer and more effective medication use.[1] These pharmacists are typically involved in ensuring appropriate prescribing and administration, monitoring patient adherence to therapy, providing drug information consultation to providers, monitoring patient responses and laboratory values, and providing patient and provider education.

Context. Emergency department (ED)-based clinical pharmacy services are relatively rare.[2] This is likely due to the unique and complex nature of the ED. The paucity of ED-based clinical pharmacy services is perplexing, given that the ED is known to be a particularly high-risk environment with frequent medication errors.[3] The 1999 Institute of Medicine report *To Err is Human* reported that the ED had the highest rate of preventable adverse events among clinical environments studied.[4-6] EDs care for approximately 110 million patients per year in the US[7]; 5% experience potential adverse drug events,[8] and 70% of these, or 3.8 million events, are thought to be preventable.[9] Clearly, adverse drug events that occur in the ED are a significant public health problem and need to be reduced, but this must be accomplished without making the ED less efficient. Published reports have asserted that ED-based pharmacists have the potential to reduce iatrogenic harm to patients.[10-13] Although this concept appears to have face value, no study has attempted to demonstrate that these programs reduce preventable adverse drug events in the ED.

Setting. The University of Rochester Medical Center is a regional trauma center, pediatric center, transplant center, and tertiary care referral hospital in Upstate New York. The ED is a 120-bed unit with five distinct treatment centers that together care for approximately 90,000 patients per year. The institution places a high priority on patient safety, and institutional and departmental leaders have pledged support for this project.

Participants. The participants in this project include the pharmacists, physicians, nurses, and patients who worked at or used the University of Rochester Medical Center/Strong Memorial Hospital Emergency Department between 2005 and 2007.

5. METHODS and 6. RESULTS and LIMITATIONS *(grouped by each specific aim)*

Study Methods Overview. The objective of this project is to implement, optimize, and formalize an expanded Emergency Department Pharmacist (EPh) Program at the University of Rochester Medical Center, to study the effect of this safe practice intervention, and to develop and disseminate a toolkit that will facilitate implementation of the

optimized program at other healthcare institutions nationwide. The EPh program was funded by the medical center and implemented on the first day of the funding period by increasing staffing in the ED to two full-time dedicated Emergency Pharmacists (EPh). This provided 80 hours per week (47% of the total hours of operation) of EPh coverage in the ED (when fully staffed) and allowed a naturally occurring experiment to occur with an intervention group (patients in the ED when the EPh is on duty) and a control group (patients in the ED when the EPh is not on duty). The program was studied through several means: a qualitative study to optimize the role for patient safety; the identification of adverse drug events (ADEs) and potential ADEs in a retrospective chart review; and a survey of physician and nurse perceptions of the program. A toolkit was also developed and disseminated through a website, with multiple means of publicity.

Specific Aim 1 Implementation of the expanded program and optimization of EDP functions and priorities to maximize effectiveness

A formal EPh program was expanded to include two full-time EPh roles, placing a dedicated, full-time pharmacist in the ED, working side-by-side with the nurses and physicians. The goal of this specific aim was to implement the safe practice intervention, based on the model created by the EPh pilot position, and to solicit qualitative feedback from staff and patients in order to optimize the program before data collection began.

Data Sources/Collection. Qualitative data were collected by two researchers using a combination of two qualitative interview strategies: the general interview guide approach and the standardized open-ended approach. Questions were designed to elicit stakeholders' perceptions of how the emergency pharmacist role could be optimized, defined as one that would be most likely to improve the quality of care and reduce adverse medication events in the ED. Participants were recruited from key stakeholder groups that included attending emergency physicians, emergency medicine residents, emergency nurses, hospital pharmacists, hospital inpatient nurses and physicians, ED patients, and emergency pharmacists. Data were collected during the interviews in the form of field notes that were transcribed within 24 hours by the interviewing investigator. Data were compiled, coded, and thematically analyzed by a review committee using the framework approach to qualitative analysis.[14] This approach involved the following steps: First, the analysis committee reviewed the raw data (transcripts) for initial familiarization in order to identify recurrent themes. Data were then coded and sorted by these themes and then mapped to define recurrent concepts and associations.

RESULTS

Forty-three interviews were conducted involving 13 emergency physicians, 13 emergency nurses, nine mid-level providers, three ED patients, two consultant physicians, two emergency pharmacists, and one inpatient pharmacist. Several areas of focus were identified. These included the visibility of the EPh, involvement in direct patient care, involvement in teaching, surveillance of medication orders, and the identification of the EPH as a resource for the ED staff. From these themes, strategies were developed to optimize the EPh's role:

1. *Maintain high visibility so ED staff are aware of EPh presence.* Staff felt that periodic rounding through all areas of the ED was important, and they felt that an increased visibility in the pediatric and nonacute areas of the ED would be helpful. The continued use of portable telephone and pager for immediate accessibility was recommended. Participants suggested that signs be posted to signify the status of the EPh (on or off duty) and suggested that the EPh become more involved with review of medication instructions related to patient discharge.
2. *Focused attention on ED patients.* Staff perceived that the emergency pharmacists' involvement with routine medication issues for inpatients who were boarding in the ED was interfering with their ability to focus on ED patients. Because boarding patients benefit from protective systems of inpatient pharmacy services, the involvement of the EPh was thought to be redundant. As a result of this finding, responsibility for boarding patients was formally assigned to inpatient pharmacy personnel.
3. *Serve as an educational resource.* Participants highlighted the importance of the EPh as an educational resource. The EPh was perceived as having a role with quality indicators, for example, in assisting staff with the administration of beta-blocker medication in acute myocardial infarction. Faculty and residents valued the EPh's distribution of current medication-related articles relevant to the practice of emergency medicine as well as their provision of follow-up papers to support advice given in the clinical setting.
4. *Be present in the ED during peak volume hours, including evening shifts and weekends.* At the time of the study, the EPh duty hours were primarily weekdays. Participants overwhelmingly expressed a desire for a shift in coverage to hours that coincided with peak patient volumes.
5. *Maintain surveillance of provider orders.* In addition to responding to direct queries from nurses and doctors, the EPh role in surveillance of medication orders was emphasized. However, participants did not express a need for 100% review of orders. Instead, a focus on higher-risk medications was desired.

6. *Respond to all trauma and medical resuscitations in the ED.* Participants reinforced the value of having the EPh present at all resuscitations. Nurses valued the assistance in preparing medications for administration, and physicians valued the clinical advice as well as what they perceived as an increase in efficiency of the medication delivery system when the EPh was present.
7. *Limit time out of unit.* Some participants perceived that the EPh was often called out of the ED for administrative responsibilities (such as committees).

Limitations. These recommendations are based on staff perceptions at this academic medical center. Ongoing research will serve to validate the patient safety effect of the optimized EPh role.

Specific Aim 2 Evaluate the impact of the EPh Program

Hypothesis: The overall event (adverse drug event and potential adverse drug events) rate will decrease by at least 25% when the EPh is present in the ED.

A chart review study was conducted to identify actual and potential adverse events that have occurred in the ED during a 12-month period, and the rate of events while the EPh is present in the ED will be compared with the rate when one is not. Data collection will focus on the pediatric, geriatric, and critically ill population of ED patients. Rigorous chart review methods will be followed in order to improve accuracy and reduce inconsistencies in abstraction.[15]

Methods

Study Design

The EPh program has been evaluated based upon the identification of *potential adverse drug events* (PADEs) and *adverse drug events* (ADEs) through a retrospective chart review.

Definitions. Definitions for this study were adopted from Harvard Medical Practice Study, along with consultation with an external advisory committee. The external advisory committee, in addition to Dr. Teryl Nichols (RAND Corporation) and Dr. David Bates (PartnersHealth), each had experience with development of chart review techniques for identification of P/ADEs. A resource and training manual was then developed to guide the nurse abstractors during the chart review process.

- *Adverse drug event (ADE)* is defined as a preventable or nonpreventable "injury resulting from medical intervention related to a drug" (Bates, Cullen, Laird et al 1995).
- *Potential adverse drug event (PADE)* is defined as an incident that could have but didn't cause injury due to intervention, chance, or special circumstances.

Case selection and record collection

Patient populations were selected that would most benefit from the presence of the EPh. Given that the elderly and critically ill are known to be populations at high risk for adverse events, these populations were most likely to benefit. Although some studies have shown ADE rates to be lower in children than in adults,[14] others have cautioned that the need for weight-based dosage and other special concerns make pediatrics a high-risk population. For these reasons, and in view of the fact that children and the elderly are considered priority populations by the Healthcare Research and Quality Act of 1999,[16] this study focused on all three populations. Patient medical records were identified by ED registration under the following criteria: children (age 18 and younger), elderly patients (age 65 and older), and critically ill patients who had been assigned to a bed in the trauma bay.

Chin[8] and colleagues report that 3.6% of patients received an inappropriate medication while in the ED, and 5.6% were prescribed an inappropriate medication upon discharge from the ED. We based our sample size calculation on the more conservative figure; we estimated that our population would have a baseline PADE rate of 5%. We consider a 25% reduction in the PADE rate with the presence of the EPh to be clinically significant. Assuming an alpha=0.05 and beta=0.2, we needed a minimum sample size of 4,202 patients in each group to have sufficient power to detect a difference in our main outcome variable, the proportion of PADE. However, we elected to increase this sample size by approximately 35% in order to allow for a more highly powered study. For the analysis of the errors themselves, the study looked for differences with respect to characteristics such as severity, preventability, and type of error. We obtained a final sample size of 10,224 patient cases, which gave us approximately 715 P/ADE forwarded by the nurse abstractors for review by the case review committee. The targeted patient populations were enrolled for both the EPh-present arm and

the EPh-absent arm with approximately equal numbers of patients. At the conclusion of the study period, our enrollment numbers resulted in 2,873 elderly patients, 3,245 critically ill patients, and 5,098 pediatric patients.

Exclusions

During the nurse abstraction process, six exclusion criteria were identified. These cases were tallied and stored in a separate Access database. The six criteria were:

- EPh Involvement – if the emergency pharmacist was referenced in the physician or nursing note during patients stay. This was done to minimize bias by ensuring that the chart reviewers remained blinded to the assigned intervention group.
- Case Investigator Involved – if one of the nurse abstractors or Case Review Committee members was involved with the patient during their stay
- Left Without Being Seen – if the patient was triaged but left prior to physician or nursing assessment
- Blue Room Exclusion – if the patient was triaged in the ED but care was followed by orthopedics only
- Psychiatric ED – if the patient was triaged in the ED but transferred directly to the psychiatric ED
- Critical Document Missing – if, after a second re-request for a chart over a 60-day period, critical documentation was still missing and we were unable to attain information from any other source

Assignment of independent variable: Definition of pharmacist-present vs. pharmacist-absent groups. Patients were assigned to the "pharmacist-present" group if the pharmacist was on duty during the first 3 hours of their stay in the ED. This time was selected a priori by consensus of the investigators, because it was felt that the vast majority of medication-related treatments take place during the first few hours of the patient's stay. In the beginning of the study period, there were two full-time emergency pharmacists (EPh), which resulted in an EPh present approximately half the time. However, one of these positions became vacant during the first year of the study period and remained open. As a result, a pharmacist was present only 24% of the time (40 hours of a possible 168 hours per week, on average).

Electronic review forms

An Access database and a data entry interface were developed and tested by research staff and optimized in terms of ease of use for efficient data entry. The database was stored on a highly secure hospital network, which had an automatic back-up system every evening. The nurse abstractors entered data directly into the database, eliminating patient data from being stored on unsecured devices. The Case Review Committee completed paper forms, which were de-identified of any patient information. A research assistant was hired to enter identified events by the Case Review Committee. For this, a second Access database was created, and all data were collected in the highly secure hospital network.

Reviewer recruitment and training. Patient records were reviewed by a nurse abstractor team that was hired for their experience in the Emergency Department; one of the nurses had expertise in pediatrics and was the sole reviewer for that population. The nurse abstractor team had a 2-day orientation period that focused on the study objectives, definitions, and examples of P/ADE; practice cases were discussed, and a training manual was provided. After the orientation period, they applied the objective criteria to screen the charts for possible events. Weekly team meetings were held to discuss the abstraction process and any recommendations for changes to the database and/or abstraction process. After a 3-month period, a reliability test was conducted for consensus on abstraction. The same 15 charts were separately reviewed by each nurse to ensure consistency with abstraction. The results of inter-rater reliability showed that the nurses were consistent with data abstraction. Any case identified with a possible event was forwarded to the Case Review Committee, where the case was independently reviewed by two physicians. The committee consisted of two board-certified emergency physicians and a board-certified pediatric emergency medicine physician. In addition, there were three consultants available if necessary: an expert in internal medicine, in toxicology, and in clinical pharmacology. The committee determined whether an event was present, the severity ranking of the error (significant, serious, life threatening, fatal), the class of medication and name of drug primarily involved, the mode of delivery, the confidence level (little or no evidence, slight to modest evidence, less than 50-50 but close call, more than 50-50 but close call, strong evidence, virtually certain evidence), and the stage of medication-use process in which the error occurred (ordering, transcribing, dispensing, administration, or monitoring). If an ADE was identified, the Case Review Committee scored the event using the Naranjo scoring technique.

Selection of populations to study. Given that the elderly and critically ill are known to be populations at high risk for adverse drug events, these populations are most likely to benefit from the interventions of an EPh. Although some studies have shown ADE rates to be less than children than in adults,[14] others have cautioned that the need for

weight-based dosing and other special concerns make pediatrics a high-risk population. For these reasons, and in view of the fact that children and the elderly are considered priority populations by the Healthcare Research and Quality Act of 1999,[16] this study focused on the following populations:

- Elderly patients (age 65 and older)
- Children (age 18 and younger)
- Critically ill patients

Cases were identified by ED registration records, using age to select the children and elderly. The critically ill or injured patients were defined as those who were assigned to a bed in the critical care/trauma bay, one of five primary treatment areas in the URMC ED. In order to reduce the potential for selection bias, there was an attempt to assign the EPhs to a balanced number of day, evening, night, weekday, and weekend shifts.

Review process. Patient charts were initially reviewed by the nurse abstractors, who were blinded to the presence of the EPh. Data abstraction included key demographics of patient, initial patient assessment at triage, physician assessment, patient history, use of ACLS/PALS, disposition, and medications – drugs administered en route by EMS, ED-ordered drugs, discharge medications, and patient-identified medications taken at home. Nurse abstractors reviewed charts for triggers as defined in the orientation/training manual for an occurrence of an adverse event. All data were abstracted directly into a Microsoft Access (Redmond, WA) database by the nurse abstractors.

If an event or potential event was identified, the case was forwarded to the Case Review Committee. The Case Review Committee, which was also blinded to the presence/absence of the EPh, reviewed the records independently and determined if an event had occurred. Consensus was reached when two reviewers agreed about the identified case. If consensus was not reached, the third reviewer and/or the expert committee determined the outcome.

Data analysis. Descriptive statistics were calculated to compare the characteristics of the two groups. The rate of events (PADE or ADE) was assessed for each group. The event rate was calculated based on number of patients who experienced an event per total number of patients. Thus, if a single patient had two events, they would only count as one event case. This approach was chosen in order to examine rates at which a person experienced an event per visit, which is consistent with approaches taken by most similar studies. These proportions were calculated and their differences were tested for significance (alpha=0.05).

RESULTS

In total, 11,809 patients were randomly selected for enrollment in the study; 1,585 of these were excluded for the following reasons: evidence of EPh involvement (2%), investigator involved (80%), psychiatry ED only (1%), left ED before being seen (6%), and missing medical record (11%). Thus, 10,224 patients were included in the final data set: 5,098 pediatric, 2,873 geriatric, and 3,245 critical care (2,282 of whom were not geriatric or pediatric) patients. Then, 2,111 (21%) were assigned to the EPh-present group, and the remaining 8,113 (79%) were assigned to the EPh-absent group. The two groups were similar, as shown in **Table SA2.1**. The time of arrival differed between the two groups, as there were more night shift arrivals in the no-EPh group. As a result, data were analyzed twice, once looking only at day shift, and another using all data.

Table SA2.1: Characteristics of the study groups

	Pharmacist NOT Present (No EPh)	Pharmacist Present (EPh)
Mean Age (years)	34	38
Gender (% Female)	45.1%	46.1%
Race		
White	65.1%	68.0%
Black	25.4%	22.7%
Other	9.6%	9.2%
Payor (% Insured)	64.0%	66.3%

The patients enrolled in the study received a total of 21,378 medication doses. The 10 most commonly administered medications were morphine (11.2%), albuterol (7.3%), ibuprofen (6.8%), propofol (8.8%), and 3% of each of the following: midazolam, acetaminophen, tetanus booster, fentanyl, hydromorphone, and nitroglycerine.

Overall event rates were calculated for all patients (events/total patients), which represented the number of events per 100 ED visits, consistent with the calculations used in the Harvard Medical Practice Studies. These results are shown in **Table SA2.2**.

Table SA2.2: Event rates, overall and by group

	All		EPh		No EPh		p value
Overall	***Events***	***Rate***	***Events***	***Rate***	***Events***	***Rate***	***t test***
ADE Events	**159**	**1.56%**	**35**	**1.66%**	**124**	**1.53%**	**ns**
Preventable	97	0.95%	21	0.99%	76	0.94%	ns
Non-Preventable	62	0.61%	14	0.66%	48	0.59%	ns
PADE Events	**162**	**1.58%**	**46**	**2.18%**	**116**	**1.43%**	**0.036**
Non-Intercepted	128	1.25%	39	1.85%	89	1.10%	0.021
Intercepted	34	0.33%	7	0.33%	27	0.33%	ns
Medication Errors	**90**	**0.88%**	**21**	**0.99%**	**69**	**0.85%**	**ns**

Quality Measures

Several quality measures were also assessed, although, because the study was powered to examine for differences in adverse event rates, and because cases meeting criteria for each quality measure were relatively infrequent, most of these measures had wide confidence intervals. Selected quality measure results are shown in **Tables SA2.3-SA2.6**. Although some had a trend toward improvement, none were statistically significant.

Table SA2.3: Patient documented as having allergy to penicillin (PCN) who receives a PCN-related antibiotic

EPh	ADEs	Allergy Violations	Index ABX Orders	% Violations	95% CI
No EPh	2	32	681	4.70%	3.24-6.57
EPh Present	0	4	179	2.23%	0.61-5.62

Table SA2.4: Patient with ED diagnosis of community acquired pneumonia (PNA) receives antibiotics in ED

Received any abx	Total PNA Cases	EPh Y/N	% Received Abx	p value (chi sq)
104	151	no EPh	68.9%	
32	44	EPh	72.7%	0.62

Table SA2.5: Urgency of pain management in fractures

Received any opioid	Fracture Cases	EPh Y/N	% Received Opioid	p value (chi sq)
221	183	no EPh	54.7%	
46	43	EPh	51.7%	0.605

Table SA2.6: Receipt of epinephrine doses on time during cardiac arrest

EPh Y/N	Arrests	Epi Right	Epi >6m	Freq Right	p (chi sq)
No EPh	123	108	15	87.8%	
EPh	29	26	3	89.7%	0.781

Specific Aim 3 Assess the acceptability of and satisfaction with the EPh by physicians and nurses

Importance. Despite the potential for emergency pharmacist (EPh) programs to improve medication safety and quality of care, very few EDs include clinical pharmacists as a part of the care team. A potential roadblock to implementation of an EPh program is the perception among hospital and ED leadership that physician and nursing staff might be unlikely to accept and seek the services of an emergency pharmacist. Some might expect resistance from ED staff, who could feel that the presence of the emergency pharmacist implies a lack of competency on their part or undermines their role in the emergency care team. Although several authors have reported on the role of the emergency pharmacist in the literature, no recent reports have examined the perceived value of this role from the perspective of emergency physician and nursing staff.

Goals of this investigation. This study aimed to assess the value of specific EPh functions and acceptance as a member of the emergency care team as perceived by nursing staff, physicians, and midlevel providers (nurse practitioners and physician assistants). We hypothesized that the majority of staff value the role of the emergency pharmacist and feel that they have a positive impact on medication safety and quality of care.

METHODS

Study Design. This is a descriptive survey study of a random sample of members of the emergency care team. Approval was obtained from the university's Research Subjects Review Board.

Selection of participants. A list of all ED staff was obtained and categorized into two groups: nurses and providers. Nurses include all Registered Nurses and Licensed Practical Nurses. Providers were defined as attending physicians, emergency medicine residents, and midlevel providers who practice in the ED. Fellows (EMS, international, and pediatric emergency medicine) were classified as attending physicians. All staff associated with this project or a larger study of emergency pharmacists were excluded. Other exclusions included part-time attendings, staff who worked exclusively in the ED observation unit, and any employees hired during the month prior to the random sampling process. Because the study started during July, 12 first-year residents, two first-year fellows, and four newly hired attendings were affected by the latter exclusion. Fifty percent of each resulting group (after exclusions) was randomly selected to receive a request to participate.

Methods of measurement. A 26-item survey instrument was developed using accepted procedures, including review of the literature, expert consensus, and integration of qualitative data that were previously obtained by the investigators from 43 interviews of staff, pharmacists, and patients. Interviews were conducted using accepted qualitative methods. Interview participants identified areas of focus that helped frame the questions, including the perceived effect of the EPh, access to the EPh, and specific functions of the EPh. The survey instrument also included demographic questions, such as role in the ED, gender, and years of experience.

Data collection and processing. An invitation to participate in the study was sent to the randomly selected staff via email. The invitation included an individually identifiable link to an electronic version of the survey instrument using a web-based survey platform (QuestionPro, Survey Analytics, Seattle, WA). Two subsequent reminders were sent to non-respondents (one per week): the first was a memo and a paper version of the survey instrument, which was placed in employee mail folders, and the second was a repeat electronic invitation. The data for paper responses were entered into the web-based survey system manually by a research assistant, and the resulting data were received from the survey vendor in a spreadsheet and electronically imported to an Access (Microsoft, Redmond, WA) database.

Data Analysis. Due to the similarity of their interactions with the emergency pharmacists, attendings, residents, nurse practitioners, and physician assistants were grouped together as "providers" for all subsequent analyses. Response rates and demographic data were analyzed using descriptive statistics.

"Agree" and "strongly agree" responses were combined into a single "agree" category; then, responses were tabulated and percent responses were calculated. Confidence intervals were calculated around the proportions using Stata 7.0 (College

Station, TX). In order to allow comparisons between survey questions, the mean value for each item was calculated on a scale of 1 to 5, in which 1 was “strongly agree” and 5 was “strongly disagree.”

RESULTS

Characteristics of study subjects. In total, 182 staff members were eligible for enrollment, and 91 were randomly selected to receive an invitation to participate in the study. Seventy-five survey instruments were completed and returned, for a 82% response rate. Of the respondents, 42 were nurses and 33 were providers, including 12 attendings, 12 residents, and 9 midlevels. One incomplete survey was returned and was excluded from the analysis. Respondents had an average of 9 years of experience in emergency medicine and 7 years of experience in the study ED. Sixty-five percent of respondents were women (54% of providers and 74% of nurses); 41% of respondents reported spending at least part of their clinical time in the pediatric area.

Results representing staff members’ general perceptions and level of interaction with the emergency pharmacists are found in **Tables SA3.1 and SA3.2** and are published in the *Emergency Medicine Journal* (Fairbanks et al, Oct 2007; 24:716-719). Ninety-nine percent of all respondents felt that the emergency pharmacist (EPh) improved quality of care in the ED, and 96% felt that the EPh was an integral part of the emergency care team. Ninety-three percent of respondents reported that they had consulted the EPh at least a few times during their last five shifts. Staff felt that the most important ways in which the EPh could maximize medication safety was by being available for consults and by attending medical and trauma resuscitations. A large majority of respondents felt that it was helpful for the EPh to check urgent orders and orders for high-risk or rarely used medications prior to administration; 83% of staff felt that the evening shift was the most important time for emergency pharmacist coverage.

Table SA3.1: General perceptions

	Overall n=75 No (%; 95% C.I.)	**Providers n=33 No (%; 95% C.I.)**	**Nurses n=42 No (%; 95% C.I.)**
“How many times in your last 5 shifts in the ED during which an emergency pharmacist was on duty, have you consulted the emergency pharmacist? (select one)”			
Multiple times per shift	18 (24%;15-35%)	6 (18%; 7-35%)	12 (29%; 16-45%)
At least once per shift	**30 (40%; 29-52%)**	**14 (42%; 25-61%)**	**16 (38%; 24-54%)**
A few times	22 (29%;19-41%)	12 (36%; 20-55%)	10 (24%; 12-39%)
Not at all	5 (7%; 2-15%)	1 (3%; 0-16%)	4 (10%3-23%)
“Which of the following do you think is most important in maximizing the emergency pharmacist’s contribution to medication safety? (select one)”			
Attend medical and trauma resuscitations	27 (36%; 25-48%)	11 (33%; 18-52%)	16 (38%; 24-54%)
Order review	7 (9%; 4-18%)	2 (6%; 1-20%)	5 (12%; 4-26%)
Being available for consult	**35 (47%; 35-59%)**	**18 (55%; 36-72%)**	**17 (40%; 26-57%)**
Staff education	6 (8%; 3-17%)	2 (6%; 1-20%)	4 (10%; 3-23%)
Patient education	0 (0%; 0-5%)	0 (0%; 0-11%)	0 (0%; 0-8%)
“Which of the following types of orders should the emergency pharmacist check before they are administered? (select all that apply)”*			
All orders	9 (12%; 6-22%)	3 (9%; 2-24%)	6 (14%; 5-29%)
Urgent orders	30 (40%; 29-52%)	14 (42%; 25-61%)	16 (38%; 24-54%)
Non-urgent orders	2 (3%; 0-9%)	1 (3%; 0-16%)	1 (2%; 0-13%)
High risk medications	**64 (85%; 75-92%)**	**29 (88%; 72-97%)**	**35 (83%; 69-93%)**
Rarely used medications	56 (75%; 63-84%)	25 (76%; 58-89%)	31 (74%; 58-86%)

*note: Multiple answers given by several respondents

The data also showed that the emergency pharmacist was perceived by staff as a valuable patient educator and teaching resource, that staff members valued EPh presence at resuscitations, and that staff members sought the advice of a dedicated EPh more often than they would seek the advice of a hospital pharmacist not located in the ED.

Responses that focus on specific duties (**Table SA3.3**) show that providers and nurses found the EPh to be useful in all situations posed. Specifically, almost all respondents felt that the emergency pharmacist was helpful in choice of medications (including antibiotics) and guidance regarding medication interactions, toxicology, and drug therapy in

Table SA3.3: Staff responses regarding specific emergency pharmacist functions

"I find the emergency pharmacist to be useful in the following situations"	type of staff	mean score*	agree or strongly agree			neutral			disagree or strongly disagree	
			n	%	95% CI	n	%	95% CI	n	%
Selection of the appropriate antibiotic.	providers (33)	1.5	30	91	76-98	3	9	2-24	0	0
	nurses (42)	1.8	33	79	63-90	9	21	10-37	0	0
	all (75)	1.6	63	84	74-91	12	16	9-26	0	0
Selection of other medications (i.e., advice on which is most appropriate).	providers (33)	1.5	31	94	80-99	2	6	1-20	0	0
	nurses (42)	1.5	39	93	81-99	3	7	1-19	0	0
	all (75)	1.5	70	93	85-98	5	7	2-15	0	0
Consultation regarding medication interactions.	providers (33)	1.5	30	91	76-98	3	9	2-24	0	0
	nurses (42)	1.2	42	100	92-100	0	0	0-8	0	0
	all (75)	1.3	72	96	89-90	3	4	1-11	0	0
Consultation regarding medication use in pregnancy.	providers (33)	1.7	29	88	72-97	4	12	3-28	0	0
	nurses (42)	1.5	37	88	74-96	5	12	4-26	0	0
	all (75)	1.6	66	88	78-94	9	12	6-22	0	0
Consultation regarding toxicology.	providers (33)	1.9	24	73	54-87	8	24	11-42	1	3
	nurses (42)	1.4	39	93	81-99	3	7	1-19	0	0
	all (75)	1.6	63	84	74-91	11	15	8-25	1	1
Making medication decisions based on medication pricing.	providers (33)	2.1	23	70	51-84	7	21	9-39	3	9
	nurses (42)	2.2	22	52	36-68	18	43	28-59	2	5
	all (75)	2.2	45	60	48-71	25	33	23-45	5	7
Making medication decisions based on medication efficacy.	providers (33)	1.6	30	91	76-98	3	9	2-24	0	0
	nurses (42)	1.5	37	88	74-96	5	12	4-26	0	0
	all (75)	1.6	67	89	80-95	8	11	5-20	0	0

*Mean score is calculated based upon the following scale: 1=strongly agree; 2=agree; 3=neutral; 4=disagree; 5=strongly disagree

Specific Aim 4 Develop and disseminate a comprehensive "Toolkit" to facilitate implementation of an EPh program in emergency departments at other institutions

During the first year of the award period, a website was designed to serve as the main conduit by which to disseminate results and tools. This toolkit website, found at www.EmergencyPharmacist.org, contains the following resources:

- An evidenced-based description of the formal role of the EPh, optimized during the initial phase-in period, using qualitative research techniques and an iterative process (Specific Aim 1). This description is provided in sufficient detail to allow other institutions to reproduce the EPh program in their emergency departments.
- A list of challenges and unanticipated barriers that occurred during the development of the program and accompanying solutions.
- An evidence-based justification for the program (based on the literature) that can be presented to hospital administrators for proposals in other institutions.
- An evidence-based description of the fact that providers and staff perceive the program as a benefit to patient safety (based on Specific Aim 3).

Dissemination. The toolkit information was also disseminated nationally through multiple means.

National Presentations

1. *Researching the use of Emergency Pharmacists in the ED.* AHRQ Annual Conference 2008, Bethesda, MD: September 8, 2008
2. *Making an Impact on Medication Safety in Emergency Medicine.* ASHP Foundation Donor Breakfast: Tackling the Tough Issues. Seattle, WA: June 9, 2008
3. *Medication Quality Standards on Emergency Medicine.* American Society of Health-System Pharmacists Summer Clinical Meeting. Seattle, WA: June 9, 2008
4. *Patient Safety Research.* Society for Academic Emergency Medicine, Patient Safety Interest Group Meeting. Washington, DC: May 30, 2008.
5. *Results of the AHRQ Emergency Pharmacist Outcomes Study.* American Society of Health-System Pharmacists 42nd Mid-Year Clinical Meeting, Las Vegas, NV: December 5, 2007.

6. Lead Story: *Using Clinical Pharmacists in Emergency Departments (audio podcast).* Healthcare 411. Agency for Healthcare Research and Quality. September, 2007.
7. *Tools for Developing an Emergency Pharmacist Program and Measuring its Effectiveness.* American Society of Health-System Pharmacists Summer Meeting, San Francisco, CA: June 25, 2007.
8. *The Emergency Pharmacist as a Safety Measure in Emergency Medicine.* AHRQ Partnerships in Patient Safety "Meet the Experts" Session. National Patient Safety Foundation Congress, Washington DC: May 2007.
9. *Designing Studies to Evaluate Safe and Effective Medication Use in the Emergency Department.* American Society of Health-System Pharmacists 41st Mid-Year Clinical Meeting, Anaheim, CA: December 5, 2006.
10. *The Systems Approach to Patient Safety.* American College of Emergency Physicians Scientific Assembly, New Speaker's Forum. New Orleans, LA: October 17, 2006.
11. *The Optimized Emergency Pharmacist Role,* AHRQ Patient Safety and Health IT Annual Conference, Washington, DC: June 5, 2006.

Research Poster Presentations

1. Kellogg KM, Fairbanks RJ, O'Connor AB, Davis CO, Shah MN. *Pain Treatment in a Pediatric Emergency Department: Associations with Pain Scores Following Implementation of Mandatory Pain Score Documentation Requirements.* Presented at the University of Rochester Medical Student Research Symposium, Rochester, NY: November 16, 2007.
2. Shannon C, Patel S, Fairbanks RJ. *Time-motion study of emergency pharmacist activity in an academic emergency department.* Presented at the University of Rochester Medical Student Research Symposium, Rochester, NY: November 16, 2007.
3. Fairbanks RJ, Kellogg KM, O'Connor AB, Davis CO, Kolstee KE, Shah MN. *Inadequate powerful Pain Treatment of Severe Pain in the ED.* Presented at the New York State ACEP Scientific Assembly. Bolton Landing, NY: July 2007.
4. Clark L, Fairbanks RJ, Kolstee KE, Shah MN. *Understanding the Nature of Adverse Events in the Emergency Department.* Presented at the New York State ACEP Scientific Assembly. Bolton Landing, NY: July 2007.
5. Hildebrand JM, Szczesiul JM, Clark L, Hays DP, Kolstee KE, Shah MN, Fairbanks RJ. *Few Academic EDs Utilize Clinical Pharmacists.* Presented at the New York State ACEP Scientific Assembly, Bolton Landing, NY: July 2007.
6. Szczesiul JM, Hildebrand JM, Hays DP, Fairbanks RJ. *Clinical Pharmacy Services are Lacking in Many Academic Emergency Departments*. Presented at the 26th Annual Eastern States Conference for Pharmacy Residents and Preceptors. Baltimore: May 2007.
7. Fairbanks RJ, Hildebrand JM, Kolstee KE, Schneider SM, Shah MN. *Nurse and doctor perceptions reinforce the value of clinical pharmacists in the ED.* Presented at the National Patient Safety Foundation Congress, Washington DC: May 2007.
8. Szczesiul JM, Hildebrand JM, Hays DP, Kolstee KE, Clark LN, Fairbanks RJ. *A survey of emergency medicine physician residency programs regarding the use of pharmacists in the emergency department.* Presented at the American Society of Health-System Pharmacists Mid-year Clinical Meeting, Anaheim, CA: December, 2006.
9. Hildebrand JM, Kolstee KE, Shah MN, Schneider SS, Fairbanks RJ. *Medical and nursing staff highly value and often utilize clinical pharmacists in the emergency department.* Presented at the University of Rochester Medical Student Research Symposium, Rochester, NY: October 20, 2006.
10. Hays D, Kelly-Pisciotti S, O'Brien T, Fairbanks RJ, Stassen NA, Cheng JD, Bankey PE, Gestring ML. *The role of the dedicated trauma team pharmacist: a pilot study to assess patient safety benefits.* Presented at the American Association for the Surgery of Trauma 2006 Annual Meeting, New Orleans, LA: September 26, 2006.

Publications by others---publicity about the project

1. Munasque A. *Out of the Pharmacy, Into the ED.* Emergency Medicine News 2008;3(8): p.1, 20.
2. Clancy CM. *Evidence shows cost and patient safety benefits of emergency pharmacists.* American Journal of Medical Quality 2008;23:231-233

3. Buckley B, Buckley J. *ASHP Report: Study Equivocal, But Faith in ED Pharmacists Still Strong.* Pharmacy Practice News January 2008; 35(1): p.1, 4-5.
4. Clancy CM. *Emergency Pharmacists: A New Road to Medication Safety (editorial).* Patient Safety and Quality Healthcare September/October 2007.
5. Clancy CM. *Practical Approaches to Improving Safety in the Emergency Department Environment (editorial).* Patient Safety and Quality Healthcare July/August 2007.
6. Strykowski JM. *Promoting Safe Medication Use in the ED: Pharmacists' role in the emergency department.* Medscape January 2007.
7. *ED nurses saved $100,000 and cut drug errors to almost zero.* ED Nursing March 2006: 9(5).
8. Young D. U.S. *Emergency Care in Jeopardy, Experts Say.* Am J Health-Syst Pharm Aug 2006: Vol 63, p.1384-1388.
9. *Pharmacist News.* New York State Journal of Health-System Pharmacy May/June 2006; 25(3): p. 7.

PI activity that furthered the implementation and increased publicity of Emergency Pharmacist Programs

(PI time concurrently funded by National Emergency Medicine Patient Safety Foundation)

1. Mentor, American Society for Health-System Pharmacists 2007 Patient Care Impact Program: Implementing an Emergency Pharmacist Program.
2. Mentor, American Society for Health-System Pharmacists 2008 Patient Care Impact Program: Implementing an Emergency Pharmacist Program.
3. Advisory Committee Member and Emergency Physician representative, American Society for Health-System Pharmacists Continuity of Care Summit, 2007.
4. Member, American College of Emergency Physicians Academic Affairs Subcommittee on Medical Errors, 2006 to 2007.
5. Expert panel participant, Delphi Panel for Prioritizing Patient Safety Outcomes Measures. RAND Patient Safety Evaluation Center for AHRQ, 2006.
6. Fellow, HRET/NPSF Patient Safety Leadership Fellowship, Health Research & Educational Trust, Chicago, IL; 2007 to 2008.

Dissemination through other means

Through advisory board member Dr. Cobaugh, the investigators established an ongoing relationship with the American Society of Health-System Pharmacists (ASHP) and the ASHP Research and Education Foundation. This relationship provided several avenues for dissemination, including multiple presentations at national professional meetings, publicity in newsletters and electronic mailing lists, and through the Patient Care Impact Program mentorship program. The ASHP Foundation also supported a grant to continue our Emergency Pharmacist research, awarded to our current Emergency Pharmacist, Nicole Acquisto, PharmD, to further examine the impact of an EPh on care of patients experiencing an acute heart attack. This work will lead to further dissemination of our results and toolkit items.

Additional Work

The following work was above and beyond originally proposed specific aims but was completed by the study team during the course of the project. All these studies will be published in manuscript form in the near future.

A. Time-motion study of the EPh

Objectives: No study has documented how an EPh spends their time. A time-and-motion study was conducted to determine how an emergency pharmacist (EPh) spends time on emergency department activities.
Methods: The study was conducted for an 8-week period during summer 2007 in a 120-bed, level-1 trauma center Emergency Department with a patient volume of 100,000 visits per year. IRB approval was obtained. Observations of

tasks performed, communication events with other healthcare providers in the ED, and methods of communication were collected. The Emergency Medicine-trained Clinical Pharmacist was followed during a convenience sample of 4.5-hour blocks of time by two medical student investigators, who recorded time spent on various activities and the type of activities performed. The activities were classified as tasks, communications, or interventions. Communication events included data on duration, mode, topic, location, direction, and interruption. Frequency and duration of events were calculated for each measure. Descriptive statistics were calculated to aid in interpreting the data.
Results: In total, 1,302 events were recorded during a total of 59 hours and 24 minutes. General patient care tasks performed by the EPh accounted for 54% of the total events recorded and 77% of total time recorded. Communication tasks accounted for 45% of total events and 22% of total time recorded. Interventions made by the EPh accounted for the remaining 0.7% of total events and 0.3% of total time recorded. Of the tasks performed by the EPh, it was observed that most time was spent assisting in the care of patients in the trauma/critical care area (24% of total time) and roaming, defined as walking throughout the ED for purposes such as checking in with staff and scanning the patient tracking boards (21% of total time). Communication was primarily with nurses, residents, and attending physicians, although time spent in communication with each group and the reasons for the communication varied. The majority of the communication events in all groups were initiated by the person in communication with the EPh.
Conclusions: The activities of which the EPh spent the highest percentage of time were communication events, roaming, and resuscitation efforts, all of which can contribute to an increased patient safety function in the emergency department. There were fewer interventions than expected, likely due to the high rate of prospective consultations given to providers and nurses.

B. Use of Clinical Pharmacists in Emergency Departments with Residency Programs
(in press, *American Journal of Health-System Pharmacy*)

Objectives: The extent of pharmacist involvement in emergency departments (EDs) is unknown. The objective of this study was to determine the prevalence and nature of clinical pharmacy services in academic EDs.
Methods: All programs listed in a national Emergency Medicine physician residency catalog in June 2006 were surveyed using a web-based survey instrument, which was developed based on literature and expert consensus. Only the primary residency hospital sites were considered. Data were compiled and analyzed using descriptive statistics and 95% confidence intervals.
Results: Of the 135 emergency medicine (EM) residency programs surveyed, there were 99 responses (73%). Eight percent of institutions reported that clinical pharmacy services were available 24 hours a day, 22% reported partial coverage, and 70% reported no coverage. Six percent reported the presence of a satellite pharmacy located in the ED and staffed by a pharmacist. The types of clinical pharmacy services reported in EDs with pharmacy coverage are reported in **Table B1**. Even among institutions that had availability of clinical pharmacists, most did not provide services that have been shown to be valued, such as drug therapy recommendations, cost-effectiveness advice, patient counseling, or medical student and resident education.
Conclusions: A minority of academic EDs provide clinical pharmacy services with a dedicated clinical pharmacist. EM residency programs should lead the way in the integration of clinical pharmacists in emergency care.

Table B1. Types of clinical pharmacy services reported by academic EDs with pharmacy coverage

Type of Service Provided	Yes	No	% Yes	95% CI
Modification of inventory based on formulary status	51	99	52	41-62%
Drug or toxicology information	47	99	47	37-58%
Medication-error or adverse-drug-reaction reporting	42	99	42	33-53%
Renal dosing advice	38	97	39	29-50%
Order clarification	39	99	39	30-50%
Teaching at ED in-service meetings	36	99	36	27-47%
Drug therapy recommendations	34	97	34	25-44%
Antimicrobial selection or dosing advice	34	99	34	25-45%
Research activities	33	97	34	25-44%

Type of Service Provided	Yes	No	% Yes	95% CI
Medication dispensing	33	99	33	24-44%
Drug interaction screening	32	99	32	23-42%
Assessment of patient contraindications to therapy	31	97	32	23-42%
Medical/trauma resuscitation participation	29	99	29	21-39%
Allergy screening	29	99	29	21-39%
Cost effectiveness advice	27	97	28	19-38%
Patient counseling or education	17	97	18	11-27%
Precepting of medical students/EM residents	13	97	13	7-22%

C. Treatment of Pain in the Emergency Department

OBJECTIVES: Treatment of pain is an important quality measure in the ED. This study aimed to 1. examine the adequacy of ED pain treatment among geriatric, pediatric, and critically ill patients with severe pain and 2. determine whether racial or gender disparity exists in the treatment of severe pain in the ED.
METHODS: The study was conducted in a large academic medical center ED. A portion of pediatric (<18), geriatric (≤65), and critically ill (any age) patients were randomly selected prospectively over a 12-month period, and trained research nurses reviewed the ED medical record to abstract age, gender, race, pain scores, all medications administered, and times. Patients with severe pain (defined as initial pain score ≥8/10) were included for analysis. Powerful pain treatment was defined as administration of an opiate or ketorolac. Race was classified as white or non-white after unknowns were excluded. Descriptive and chi square statistics were calculated.
RESULTS: Overall, 10,104 patients were enrolled: 34% non-white (2% unknown race), 55% male, 47% pediatric, 28% geriatric. Twenty-three percent had no pain score recorded. Among the 1,728 (17%) who arrived in severe pain, 29% did not receive any pain treatment (95% CI, 27%-31%), and 50% never received powerful pain treatment (95% CI, 47%-52%). Prevalence of non-treatment with powerful meds was worse among non-white patients (46% treated vs 59% in white; p<0.001), women (47% treated vs 52% for men; p<0.001), and pediatric patients (28% treated vs 52% for geriatric; p<0.001). White patients received more pain medication overall (73% treatment vs 66% for non-white), as did men (73% vs 68%). The highest rate of pain treatment was in the critically ill population, both for any pain med (83%) and for powerful pain meds (78%; 95% CI, 74%-81%).
CONCLUSION: In this population, a surprisingly small proportion of patients with severe pain received powerful treatment. Additional exploration is needed to determine why. Explanations include opportunities for improvement in documentation or in attention to pain.

7. LIST OF PUBLICATIONS and PRODUCTS (Bibliography of Outputs from the study.

(FOR PRODUCTS: SEE SA#4 DESCRIPTION ABOVE)

**PUBLICATIONS. *****Note: development of manuscripts is ongoing, and several publications are forthcoming, including the primary outcomes from Specific Aim #2.*

Peer-Reviewed Articles

1. Szczesiul JM, Fairbanks RJ, Hildebrand JM, Hays DP, Shah, MN. Use of Clinical Pharmacists in Emergency Departments with Residency Programs. American Journal of Health-System Pharmacy (in press).
2. Fairbanks RJ, Hildebrand JM, Kolstee KE, Schneider SM, Shah MN. Medical and nursing staff value and utilize clinical pharmacists in the Emergency Department. Emergency Medicine Journal Oct 2007; 24:716-719. [#2 most read article, October 2007 EMJ)
3. Fairbanks RJ, Rueckmann RA, Kolstee KE, Hays DP, Cobaugh DJ, Wears RL, Dewar KH, Martin HA, Davis CO, Schneider SM, Shah MN. *Clinical Pharmacists in Emergency Medicine*. In: Advances in Patient Safety: New Directions and Alternative Approaches. Rockville, MD: Agency for Healthcare Research and Quality; 2008.

Published Research Abstracts

1. Fairbanks RJ, Rueckmann EA, Davis CO, Kolstee KE, Lerner EB, Shah MN, *Adverse Drug Events With and Without a Pharmacist in an Academic Emergency Department* (Abstract). Academic Emergency Medicine May 2008 15(5): S28-29.
2. Szczesiul JM, Hildebrand JM, Clark L, Hays DP, Kolstee KE, Shah MN, Fairbanks RJ. *Use of Clinical Pharmacists in Academic EDs is Limited* (Abstract). Academic Emergency Medicine May 2007 14(5): S87-88.
3. Hildebrand JM, Fairbanks RJ, Kolstee KE, Schneider SM, Shah MN. *Medical and Nursing Staff Highly Value Clinical Pharmacists in the ED* (Abstract). Academic Emergency Medicine May 2007 14(5): S200-201.
4. Fairbanks RJ, Kolstee KE, Martin HA, Dewar KH, Rueckmann EA, Shah, MN. *Prehospital Pain Management is not adequate* (Abstract). Prehospital Emergency Care 2007; 11(1): 134.

Website Development

1. www.EmergencyPharmacist.org

Associated Publications and Presentations (not grant supported, but related)

1. Conners GP, Hays D, Emergency Department Drug Orders: Does Drug Storage Location Make a Difference? Annals of Emergency Medicine Oct 2007; 50(4): 414-418.
2. Fairbanks RJ, Hays DP, Webster DF, Spillane LL, Clinical Pharmacy Service in an Emergency Department. American Journal of Health-System Pharmacy, 2004; 61(9): 934-937.
3. Fairbanks RJ and Hays DP. *The Emergency Department Pharmacist: A novel Approach to Error-Reduction in Emergency Medicine*. Presented at the National Patient Safety Foundation Congress, Boston: May 2004.

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